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(54) A SECURITY SYSTEM FOR CONTROLLING THE LABELLING AND PACKAGING OF PRODUCTS

(71) I, DAVID BLYTHE FOSTER, a British subject, of White House, Sunninghill Road, Windlesham, Surrey, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a security system for labelling and packaging products and has for an object the minimisation of errors that cause incorrectly labelled material to leave a factory.

A specific field of use of this invention is the packaging of drugs and such like products where a mistake in labelling may cause bodily harm and even, in an extreme case, death, to a subsequent user of the product. Clearly, however, the invention is not limited to such a use and may find overall application in practically any industry where products are packed automatically or semi-automatically.

In industrial undertakings, certain security precautions are taken in an attempt to ensure that all goods are correctly packaged and labelled when they leave the factory and these precautions may be summarised as a set of rules that must be followed by handling personnel but nevertheless mishaps occur due to accident, inadvertence or sheer carelessness. Clearly the weak point in any security system is at the place where two (or more) things come together so that the fundamental security problem relates to an assembly process.

In studying this problem, I have come to the conclusion that there can only be two states, viz. security and anti-security. Every happening must fall within either one of these two stated categories.

The invention consists in a security system for controlling the labelling and packaging of products, each stage of said system having a plurality of input channels arranged to receive separate inputs derived from product-associated elements, each said element being coded for identification by the system, and wherein the coded information related to said elements is compared for coincidence by electronic logic.

From another aspect, the invention consists in a security system for controlling the labelling and packing of products, wherein at each stage, the identity of a plurality of separate coded inputs thereto are automatically electronically recognized by a code detection system related to each respective input and wherein the codes are automatically compared for coincidence by electronic logic.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings showing diagrammatically certain aspects and features thereof by way of example, and in which:—

Figure 1 shows an electrical analog for an AND gate,

Figure 2 shows the logical diagram of an AND gate,

Figure 3 shows an electrical analog for an OR gate,

Figure 4 shows the logical diagram for an OR gate,

Figure 5 shows a serial identity system to illustrate the problems under reference,

Figure 6 shows a first embodiment of system according to the invention which is hereinafter referred to as a serial identity assembly system,

Figure 7 shows a second embodiment of the invention which is hereinafter referred to as an identity assembly system with common master code,

Figure 8 shows a third embodiment of the invention, hereinafter referred to as a serial identity aggregation system with common identity master, and

Figures 9 to 12 show various examples of label coding.

Hereinafter will be described a security system of a type involving philosophical locks and keys whereby the lock and key functions are established by unique patterns of binary digits setting up unique information codes. Such systems are established in the electronic art by means of code verifiers which feed to AND gates, the latter of which have a plurality of inputs and only one output wherein the output can only give an output signal when all the AND gate inputs are simultaneously actuated. Each verifier output will actuate a respective AND gate if the combination of the signs of binary digits i.e. "1" and "0" are in a correct predetermined coded arrangement. I define a 2-AND system as one in which two such coded input systems are involved in that both such coded verifiers must be registering output signals to the AND gate for the AND gate to operate, whilst I define a 3-AND system as one in which three such coded gate systems all and each are providing an output signal for the gate to operate. A 2-AND system can be considered as the analogue of a lock which requires two keys to open it whilst a 3-AND system can be considered as the analogue of a lock which requires three keys to open it.

In the drug security system described herein, the individual inputs to the verifiers are provided by codes derived from markings on labels, containers and punched cards and typically a 3-AND system would require the correct identical coincidence of codes from a punched card, from code markings on a bottle and from code markings on a label.

Referring now to the drawings, in the AND gate of Figure 1 current will only flow if switches A and B and C are all simultaneously closed. The logical analog is shown in Figure 2. In the OR gate of Figure 3, current will flow if one or more of the switches A, B or C are closed. Figure 4 shows the logical analog.

Figure 5 schematically shows a serial assembly system of the kind customarily used in industry where the product identified at A is put into a primary container such as a bottle B which must then be associated with the correct bottle label C after which the labelled bottle is packaged, if desired into a secondary container D, for example a carton, after which a tertiary container E may be employed, such as a box. Labels may have to be applied also to the secondary and tertiary containers D and E although generally these secondary and tertiary containers are pre-printed or marked.

There are several degrees and forms of the above, but that shown in Figure 5 is typical of a main line flow system.

The problem is to ensure that the identity of marking in the assembly additions (Bottle, Bottle Label, Container, etc.) correspond to the true product identity.

Thus, the problem (see Figure 5) essentially occurs at the points A, B, C, D, E at each of which one must at least know:—

(a) The preceding Main Line identity which relates essentially to the *product* identity.

(b) The added identity in the assembly process which must be corresponding to the preceding identity.

The invention may be applied to three alternative security systems which can be used selectively to protect security in an assembly process, and these are:

a) The Serial Identity Assembly System,

b) The Identity Assembly System with Common Master Code, and

c) The Serial Identity Aggregation System with Common Identity Master.

All these systems involve the AND security principle discussed above, and will now be more fully explained.

a) *The Serial Identity Assembly System*

This system consists (as shown in Figure 6) of making an identification of an item at the beginning of a process (for example, on an original bottle or phial), and passing this down the line as the main identification, but transferring this main identification to the next stage at the time when the earlier identification has been obscured by successive packaging. Thus, for example, as soon as a bottle has been put in a carton, then the marking on the carton must be used, for the main identity to refer to the next stage, such as "boxing", i.e. a stage where several containers are put into a box.

This system suffers from a disadvantage in that, if a mistake is made, it is hidden and becomes self-perpetuating through the rest of the process. Apart from stripping open the package and getting at the original bottle markings, there is little protection from an error of this kind.

b) *The Identity Assembly System with Common Master Code*

With this system (see Figure 7) the first thing is to originate a Common Identity Master Code. In a typical example this would be entered on a punched card having coded holes to establish a unique code for the product and all its successive labelling. This Master has to be originated and checked in a Security Department of the factory, since it establishes the common KEY to the whole procedure. The Common Identity Master is not, itself, attached to any item but is, as it were, the master pass key.

Then, in various assembly processes, all new input of additions to the process have to be compared, (for example as to coding

on labels) to the identity of this master.

This system is very much better from a security aspect than the system of Figure 6.

c) *The Serial Identity Aggregation System with Common Identity Master*

This system is an extension of that of Figure 7, wherein both inputs to the process at any stage (both Main Line and New Added Item) are checked for identity against a Common Master Code as shown in Figure 8. This system is virtually saying:—

Input 'A' AND input 'B' AND master 'C' must agree.

This essentially 3-AND system is an excellent security system.

Based on the above desiderata, there is now given:—

1. A proposal for the general automatic methods to be used throughout the system of the invention.
2. Proposals for modular units which can be assembled together in various ways to suit the requirements of the different automatic inspection points.
3. Typical systems which can be built up from the standard modules.

These proposals are all allied to a security system for use in the packaging of drugs as an example.

1. *General Notes on Proposals for Automatic Methods*

Required Operation or Materials	*Short Reference*	*Proposed General Technique*
Types of Punched Cards:	CDC	A Captive Drug Card for attachment to a bulk supply of drugs, such as a prime bottle or box, and with an extendable lead so that the punched card can be extended to be put in a card reader.
	CMC	Commercial Master Card which contains the full drug coding and all container and label codings. Used for label printing verification at label production, and at the assembly stages in the production line.
Production of punched cards		By decimal typewriter with automatic conversion to punched ternary code.
Verification of punched card		At the same station as where produced with automatic decimal readout display from ternary decoding.
Verification of label, etc.		By printing labels from a printing block and automatically checking the code desired from the label against the CMC. This system can also be used for general label checking before the production line.
Material of punched cards		Resin bonded fabric Bakelite (Registered Trade Mark).
Label marks		Preferably black or dark on a lighter background.
Packaging and Labelling Process:—		
a) Prime filling stage		Automatic check at filling machines between: CDC; (bulk) CMC; Code derived from individually marked primary containers (or phial) or from a card accompanying a batch (e.g. a tray) of such containers.
b) First labelling stage of filled phials, bottles, etc.		It appears desirable, in view of the fact that the same phial (etc.) can carry labels in different languages, that phials (etc.) are filled irrespective of such variation. Thus the output from the previous stage is unmarked except for the accompanying card attached to the tray or the individual marks caused by the phials. It is proposed that the first labelling stage involves the collaboration of:—

Required Operation	*Short Reference*	*Proposed General Technique*
		Code derived from individually marked primary containers (now filled) or from a card accompanying said containers; CMC; Code as read from an added label.
(c) Subsequent additional packaging		This consists of the collaboration of:— CMC; Code pertaining to the product of the previous packaging or labelling operation; Code pertaining to the item to be added (e.g. label or container). This arrangement will apply to all subsequent stages of packaging at which both incoming products for assembly carry respective individual code marks, for common check against the CMC.

2. *Proposals for Modular Units for Automatic Inspection Systems*

The above listing of the automatic operations required indicates that a number of different techniques is required but most having some common features. Therefore, a modular approach to the required components based on the common features is recommended as follows:—

General Technique

All electronic circuits necessary may be composed of integrated circuit units mounted on 80-way plug-in boards. Mechanically all units made from modules may be mounted on standard panels for example those known in Great Britain as "19 Post Office panels", having been set up as a design standard by the British Post Office, and being 19 ins. (482.6 mm) wide, and such units may be mounted into standard commercially available cabinets.

Module or Unit	*Description*
"EC" — Electronic Chassis	A skeleton chassis to take about 20 plug-in 80-way boards complete with constant voltage power unit and all mounted on a Standard Panel.
"SPB1", SPB2, etc. — System plugboards	A plug-in 80-way board (for engagement with "EC") and which is wider to suit the different arrangements required and thus controlling the key connections to other boards.
"PCOU" — Photocell Optical Unit	A self-contained separate unit comprising lamps, optics and photocells for positioning in front of a label to read its code. The unit to be preferably of the pre-focussed dowelled type so that a new unit can be quickly replaced in the event of failure of lamp, etc. Each typical electronic system will have a characteristic system board SPB1, SPB2, etc.
"PCPB" — Photocell plugboard	A plug-in (to "EC") 80-way board capable of receiving the outputs of a set of photocells associated with a given photoelectric measurement of a label code complete with pre-amplifiers and Schmitt trigger circuits.
"LCU" — Lamp control unit	A standard Panel on which are mounted rheostats for controlling the photocell lamps together with measuring meters for cell currents and setting trigger points. The output of the PCOU will go first to this unit

Module or Unit	*Description*
	prior to being taken to the PCPB described earlier. This unit also includes a rectified stabilised source of lamp power supply. It may cater for two PCOUs.
"PCR" — Punched card reader	Mounted on a Standard Panel, this can accept a punched card and detect the holes.
"MR1", "MR2", etc. Message Register plugboards	A series of different 80-way plugboards wired and fitted with various patterns of electronic components to establish functions such as:— Message registration Coding Decoding Binary-Decimal Display Decimal Display Drivers
DD Decimal Display	Mounted on a Standard Panel this unit gives a 99999 visual display of decimal numbers for visual checking of punched card, etc.
TCP Typewriter card punch	A typewriter keyboard into which can be typed a set of decimal numbers and which in collaboration with separate electronics can punch a coded punched card.
AA Actuator-Alarm Unit	This unit may be mounted on a Standard Panel and has two functions:— To raise an audible and visual alarm on receipt of an incompatible code. To provide a relay control to stop a machine or machines.

3. *Typical Modular Systems*

Having indicated the nature of the above modules or units, the following can be built up from them: for convenience, the various modules or units are referred to by their initial letters as set out in the following key:

Key to the standard ten modules or units

EC	Electronic chassis
SPB1, etc.	System plugboards
PCPB	Photocell plugboards
LCU	Lamp control unit
PCOU	Photocell Optical Unit
PCR	Punched card reader
MR1, etc.	Message register and data-processing boards
DD	Decimal display
TCP	Typewriter card punch
AA	Actuator-Alarm Unit

System		*Units Required*
Punched card Production and verification		TCP EC SPB1 MR1 etc. (various) DD PCR
Verification of printing blocks and labels		EC PCOU LCU PCPB SPB2 MR1 etc. (various) DD AA
Prime Filling Stage (Comparison of Identity Master Card; Coded Drug Card; and card accompanying batch of empty containers).	Three	PCR EC SPB3 MR1 etc. (various) AA

System	*Units Required*	
First Label addition (Comparison of Identity Master Card; card accompanying batch of filled containers; and code read from the label to be applied).	Two PCR PCOU LCU EC SPB4 PCPB MR1 AA	etc. (various)
Subsequent assemblies involving two labelled items being checked to a punched card (Comparison of Identity Master Card; code read from the product of the previous stage; code read from item to be added to the product of the previous stage).	PCR PCOU LCU DC SPB5 Two PCPB MR1 AA	etc. (various)

In order for the systems to operate by automatic recognition techniques, appropriate codes must be employed for marking the containers, e.g. bottles or phials on their labels.

Codes for labels

A label code is a set of symbols which can be used to represent a type of product. The most commonly used codes involve decimal numbers, i.e. the symbols 0-9. Digital computers normally use a binary code, i.e. two symbols, since these can be denoted by the presence or absence of an electronic signal at a given time or place. Hence the binary symbols are written 1 and 0, as is well known to those skilled in the art.

A label may be marked with magnetic ink and thus be capable of being "read" and identified by magnetic heads, or may be provided with marks which can be "read" photoelectrically. These may be black marks or punched holes: marks need not be in the visible spectrum provided a suitable transducer is used, as in the case of phosphorescent marking or nuclear radiation detectors.

If a hundred items are to be coded, then seven rows of a binary coded binary system are required ($2^7 = 128$).

The coded label in Figure 9 has the code $1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 + 0 \times 2^4 + 1 \times 2^5 + 0 \times 2^6 = 45$. The reader registers the '1' by the presence of a black mark, and the '0' by its absence. This requires that the reading device shall inspect every $\frac{1}{4}$ inch of the label after it enters the reader and assumes a constant speed of label passage, assuming a $\frac{1}{4}$ inch spacing of the code marks. Since this is not likely to occur in practice, it is necessary to have a further set of reference marks with a second photocell as in Figure 10. Alternatively, Figure 11 shows the same code with inversion. Electronic logic circuits can then be used after the reading heads to check that the rows are the inverse of each other, otherwise incorrect marking or reading has occurred and the label is rejected.

It may arise, with certain labels or containers with only $1\frac{1}{2}$ inch square area for code marks, that there is not enough space for several hundred different code combinations using two rows of marks. Figure 12 shows a three-row method with a septal code. This would allow 343 combinations with only three rows; four rows would give 2401 combinations.

If a cylindrical bottle must be read for code marks, a further column may be added with another mark to instruct the photocell when to start reading. This reference position is necessary for the start; the finish position will be from a count of rows.

WHAT I CLAIM IS:—

1. A security system for controlling the labelling and packaging of products, each stage of said system having a plurality of input channels arranged to receive separate inputs derived from product-associated elements combined at that stage, each said element being coded for identification by the system, and wherein the coded information related to said elements is compared for coincidence by electronic logic.

2. A security system for controlling the labelling and packaging of products, wherein at each stage, the identity of a plurality of separate coded inputs theretoo are automatically recognized by a code detection system related to each respective input and wherein the codes are automatically compared for coincidence by electronic said different inputs.

3. A system as claimed in claim 1 or 2, wherein the different inputs consist of a) the product code communicated by an accompanying identifying punched card, and b) a container code, the container itself bearing

the code marks and/or having an attached label bearing the code marks, said inputs being separately compared by electronic means by reference against a separate master punched card and wherein non-coincidence of said inputs on decoding actuates alarm means.

4. A system as claimed in claim 1, 2 or 3, wherein at least some of the codes are marked with magnetic ink adapted to be read by magnetic heads.

5. A system as claimed in claim 1, 2 or 3, wherein at least some of the codes are constituted by markings adapted to be read by photoelectric means.

6. A system as claimed in claim 5, wherein the markings are either opaque or formed by punched holes.

7. A system as claimed in claim 5, wherein said markings are not in the visible spectrum but are such that they may be read by suitable transducing means.

8. A system as claimed in claim 1, 2 or 3, wherein at least some of the codes are constituted by markings in phosphorescent material.

9. A system substantially as hereinbefore described with reference to the accompanying drawings.

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1323552 COMPLETE SPECIFICATION
5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

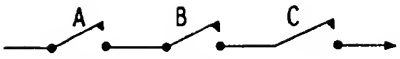


FIG.1 ELECTRICAL AND GATE

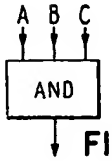


FIG.2

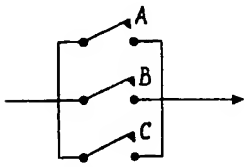


FIG.3 ELECTRICAL OR GATE

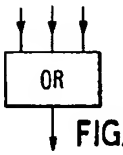


FIG.4

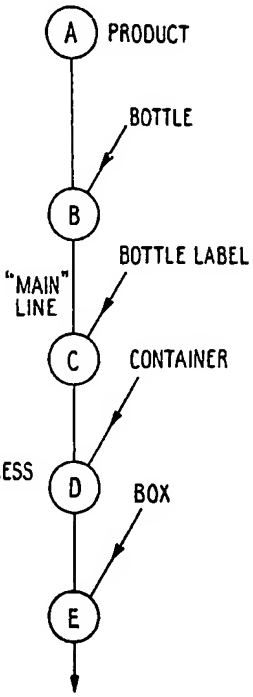


FIG.5
ASSEMBLY PROCESS

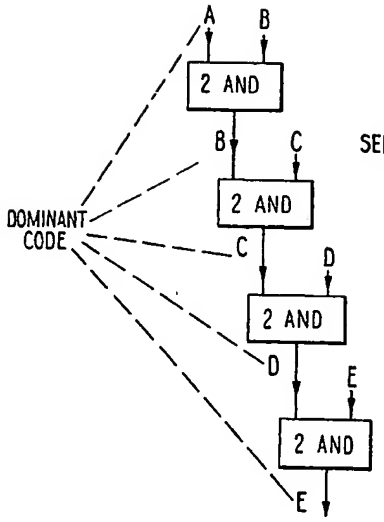


FIG.6
SERIAL IDENTITY ASSEMBLY SYSTEM

A-- PRODUCT
B-- BOTTLE
C-- BOTTLE LABEL
D-- CONTAINER
E-- BOX

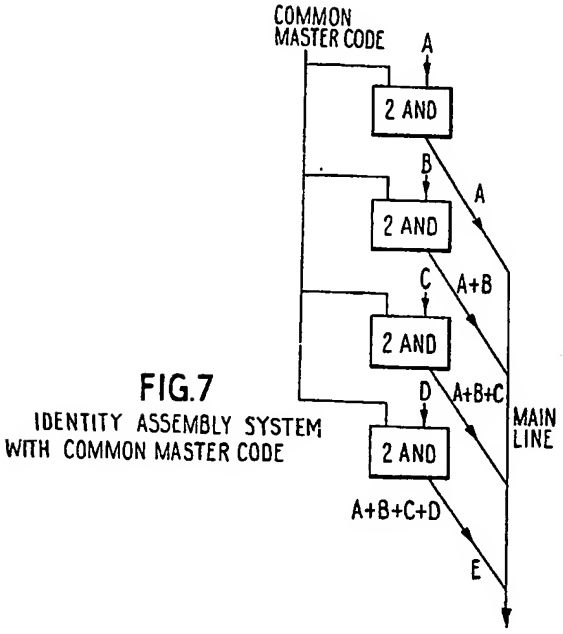


FIG.7
IDENTITY ASSEMBLY SYSTEM WITH COMMON MASTER CODE

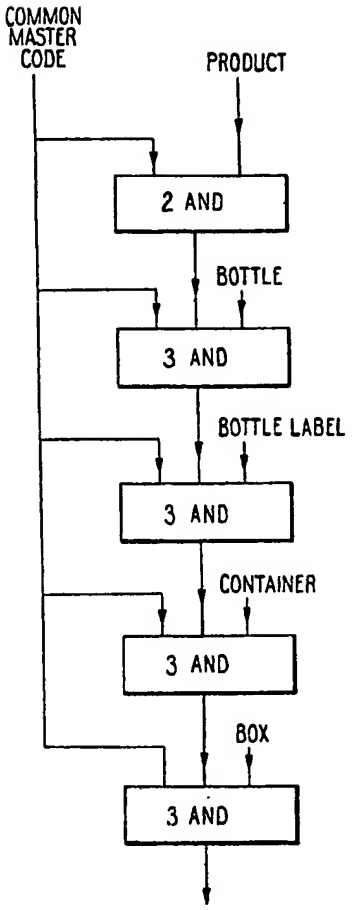


FIG.8
SERIAL IDENTITY AGGREGATION SYSTEM WITH COMMON IDENTITY MASTER

FIG.9

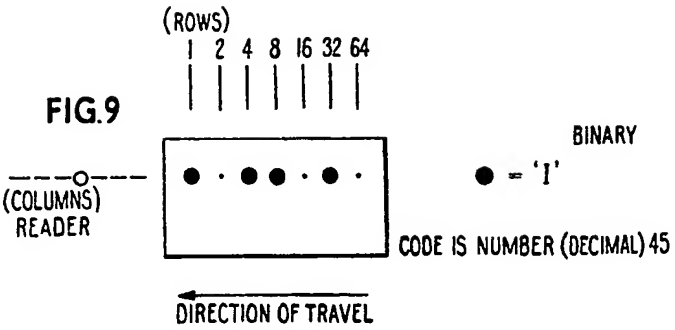


FIG.10

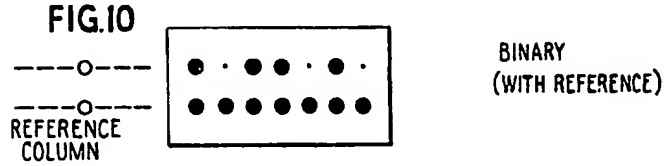
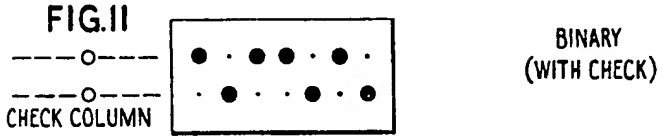


FIG.11



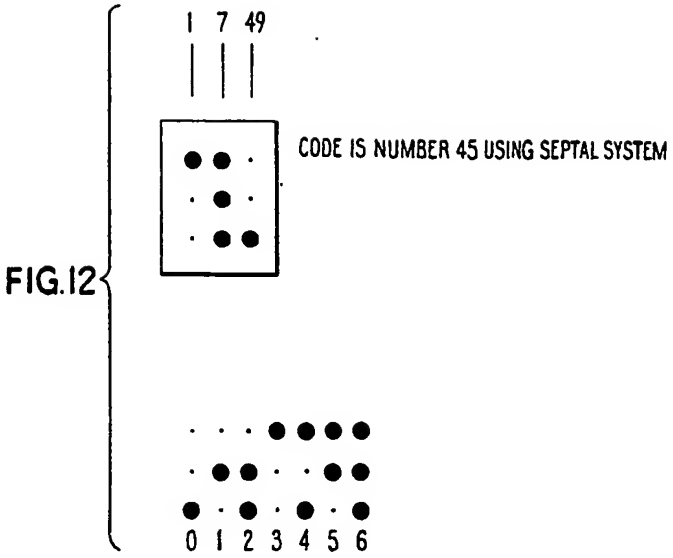


FIG.12